

STUDIES OF IRON IMPURITIES IN $Y_xPr_{1-x}Ba_2Cu_3O_{7-\delta}$

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Pr is the only rare earth which, when substituted for Y in $YBa_2Cu_3O_7$, significantly alters the superconducting transition temperature, T_c , without changing the crystal structure. For $Y_xPr_{1-x}Ba_2Cu_3O_{7-\delta}$ with $\delta \approx 0$, T_c is reduced rapidly as x is increased, reaching zero for x about 0.5. For x above 0.5 the compound is antiferromagnetic with a Neel temperature that increases with increasing x, rising to above room temperature for x near 1. A similar behavior is observed when the oxygen deficit δ is increased from zero to 1 with x=0. For the case of Pr substitution, the drop in T_c is believed due to magnetic interactions. For the case of varying δ with x=0, the drop can be attributed to a combination of magnetic interactions, band filling, and changes in crystal structure. To study these effects, the Mossbauer effect of ^{57}Fe atoms substituted for the Cu atoms has been observed as a function of δ , x, and temperature. The observed spectra are all well described by a two quadrupole-split pairs, a central singlet, and a six-line magnetic hyperfine field pattern. For several Pr compositions both δ and temperature were varied, and the results support the hypothesis that a magnetic interaction exists between the Fe in the Cu lattice and the substitutional Pr atoms.